

# Chapter Two: Property Description and Petroleum Potential

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# **Chapter Two: Property Description and Petroleum Potential**

## **A. Property Description**

The Copper River basin Study Area consists of approximately 2.4 million acres in the Copper River valley, Alaska. The Copper River forms the eastern boundary of the study area. Other rivers flowing through the area include the Gakona, Gulkana, Tazlina, Nelchina, and the Tyone. Prominent waterbodies include Lake Louise, Lake Susitna, Old Man Lake, Crosswind Lake, and Ewan Lake. The Trans-Alaska Pipeline System runs in a north-south direction through the study area, which is also crisscrossed by the Glenn, Richardson, and Edgerton Highways. Some residents live in communities off the road system, like Nelchina and Tyone Village, but most live in highway towns, including Chistochina, Gakona, Gulkana, Glennallen, Tazlina, Copper Center, Kenny Lake, and Lower Tonsina. General land status is depicted in Figure 2.1.

Surface property owners include the state, Bureau of Land Management (BLM), Ahtna Incorporated, Alaska Mental Health Trust, and private individuals. Most of the western half of the study area is owned by the state. Property in the eastern half is owned mostly by Ahtna, Inc. and the federal government. There are numerous smaller private parcels throughout the study area, including dozens of lots surrounding Lake Louise, Lake Susitna, and Tyone Lake.

The study area includes public lands managed by BLM, the National Park Service, and the state of Alaska. Public recreation areas include the Gulkana and Lake Louise State Recreation Areas (SRAs), located at Gulkana and Lake Louise respectively. The Dry Creek State Recreation Site (SRS) is located adjacent to the Gulkana airport. Both Tolsona Creek and Little Nelchina Creek SRS are located on the Glenn Highway. Sourdough Creek campground, located at mile 147.5 of the Richardson Highway, is operated by BLM. A portion of the Nelchina Public Use Area overlaps about 370,000 acres of the study area. About one third of the study area in the west is included in the Matanuska-Susitna Borough.

The Gulkana River flows through a portion of the study area. In 1980, The Alaska National Interest Conservation Act (ANILCA) established the upper portion of the Gulkana River, including the Middle Fork and West Fork, as a component of the National Wild and Scenic Rivers System to be administered by the Secretary of the Interior through the BLM. There is a management plan for this corridor and a Memorandum of Understanding (MOU) regarding management was signed by the state of Alaska and BLM in 1985 (BLM, 1985).<sup>1</sup> This river system flows through Ahtna, Inc. lands and three BLM-managed easements established by ANCSA. Public Land Order 6329 opened most of this land adjacent to, but not within, the river corridor for mineral location and oil and gas exploration under the United States mining and mineral leasing laws (BLM, 1999)(1983).

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<sup>1</sup> For the purposes of the MOU, the Gulkana National Wild River and the National Wild and Scenic River corridors are defined as all land and water within the outer boundaries of the approved river management plans as provided for by ANILCA (BLM, 1985).

The study area contains lands in which the state owns both the surface and subsurface estate. Ahtna, Inc. and Alaska Mental Health Trust also have subsurface ownership rights.

## **B. Subsurface Property and the Public Interest**

In the late 1950's, Congress was debating the Alaska Statehood Act. A major concern was Alaska's ability to support itself since it did not have any significant source of revenue. Statehood proponents saw federal land grants including the underlying natural resources as a way to secure the new state's financial well being.

The Statehood Act allowed Alaska to select 104 million acres of federal land as its economic base. The land grants included the right to all minerals underlying these selections. The Act specifically required the state to retain these mineral interests when conveying interests in the surface estate stating "mineral deposits in such lands shall be subject to lease by the State as the State legislature may direct" (P.L. 85-508, § 6(i)).<sup>2</sup> Additionally, the Act provided that if Alaska disposed of its mineral estate contrary to the Act, it would have to forfeit that mineral estate to the federal government.

In keeping with the Act, the Alaska Constitution mandates the state's policy: "to encourage ... the development of its resources by making them available for maximum use consistent with the public interest" and the "legislature shall provide for the utilization, development and conservation of all natural resources belonging to the state, ... for the maximum benefit of its people." Alaska Constitution, art. VIII, §§ 1, 2.

To comply with this mandate, the legislature enacted Title 38 of the Alaska Statutes and directed ADNR to implement these laws. The legislature explicitly found that the people of Alaska have an interest in the development of the state's oil and gas resources and to maximize the economic and physical recovery of those resources. AS 38.05.180(a). The legislature found that it is in the best interests of the state to encourage an assessment of its oil and gas resources. Congress, the drafters of the Alaska Constitution, and the Legislature intended that the subsurface estate belong to and financially benefit all Alaskans. When state surface land is conveyed to an individual citizen, state law requires that the deed reserve mineral rights for the state (AS 38.05.125).

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<sup>2</sup> There are two types of interests or ownership in land, the surface estate and the subsurface or mineral estate. The interests may become separated when an original owner keeps only the surface estate and sells the subsurface, or when an owner sells only the surface and keeps the subsurface to sell or use later. Therefore, the surface and subsurface interests may be separate, and a property or homebuyer could buy land but acquire only the surface estate.

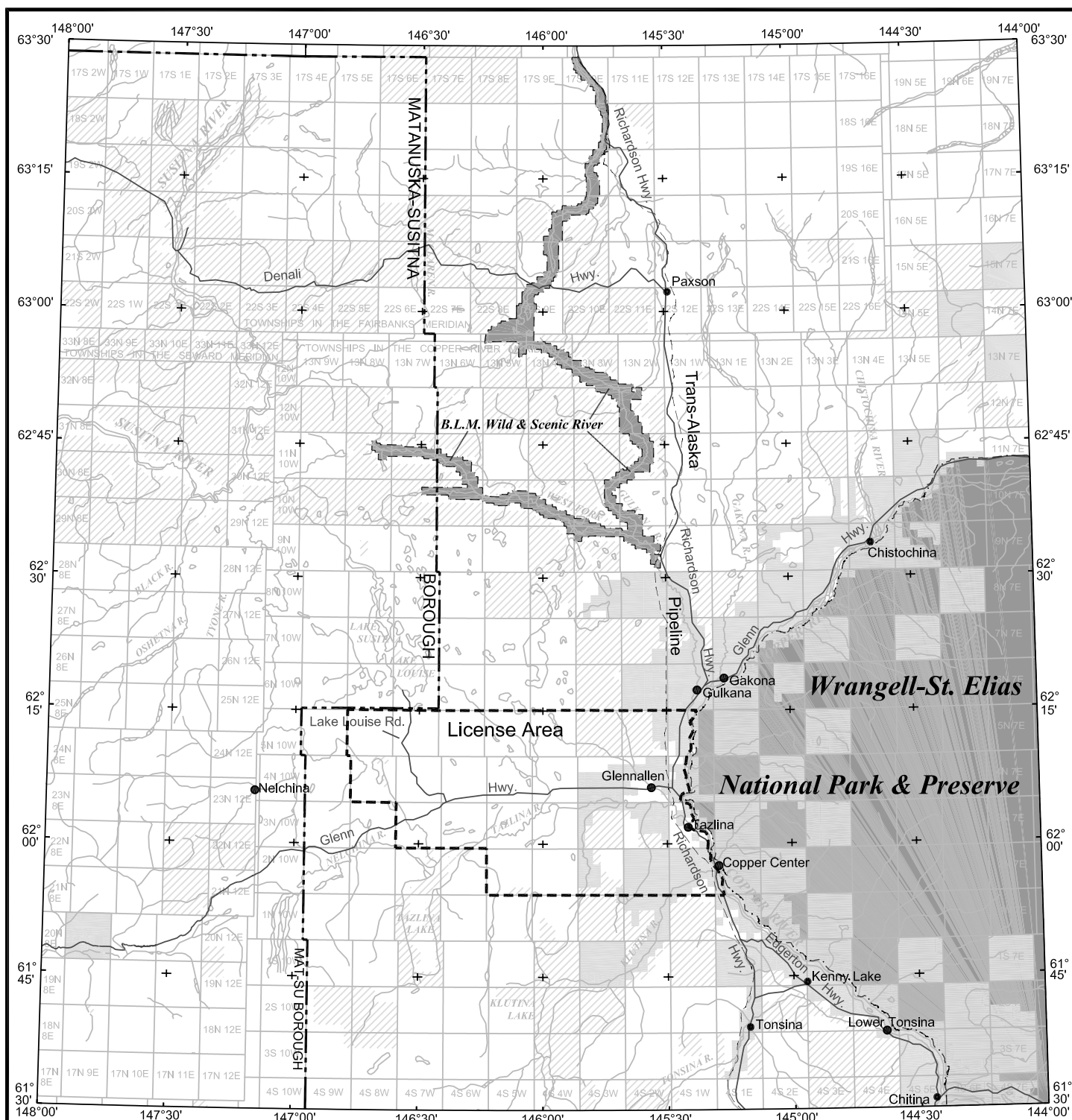


FIGURE 2.1 Copper River Basin Exploration License: General Land Status

License Area = [dashed line]

B.L.M. Lands = [diagonal lines]

Federal Designated Area = [solid black]

Native Corporation Lands = [solid gray]

SCALE 1:1,000,000 One Inch = 17.5 Miles Approx.

(ANCSA Pat. or Interim Conveyed)

Source: ADNLR LRIS, AK Gen. Land Status, 2/00.

Albers Equal-Area Conic Projection, 1927 North American Datum, Clarke 1866 ellipsoid with a central meridian of 146°, origin latitude of 50°, northern parallel of 65°, and southern parallel of 55°.

Map created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas.

ADNR, DO&G 6/00, Rev. 7/00

## C. Geology

Bordered on the north by the Alaska Range, on the east by the Wrangell Mountains, on the south by the Chugach Mountains, and on the west by the Talkeetna Mountains, the Copper River sedimentary basin is a topographic lowland encompassing an area of approximately 3,500 square miles. Glacial moraines, glaciated ridges, and alluvial valleys characterize the basin's low-relief topography.

**Table 2.1 Geologic Time**

Eras	Periods	Epochs	Began Approximate Number of Years Ago
	Quaternary	Holocene (Recent) Pleistocene (Glacial)	10,000 1 million
		Pliocene	7 million
Cenozoic		Miocene	25 million
	Tertiary	Oligocene	40 million
		Eocene	60 million
		Paleocene	68-70 million
	Cretaceous	Late and Early	135 million
Mesozoic	Jurassic	Late, Middle and Early	80 million
	Triassic		225 million
	Permian		270 million
	Pennsylvanian		325 million
	Mississippian		350 million
Paleozoic	Devonian		400 million
	Silurian		440 million
	Ordovician		500 million
	Cambrian		600 million
Adapted from Webster's Ninth New Collegiate Dictionary, 1991:512 and AEIDC, 1975:37			

Surficial deposits typically consist of Quaternary glacial, lacustrine and alluvial sediments with local exposures of undeformed Tertiary continental deposits. Numerous low-rank (lignite) coal seams occur throughout the Tertiary section, which is a thickness less than 3,200 ft. (Kirchner, 1994). Beneath the Tertiary interval are Mesozoic, Triassic through Cretaceous, rocks of the Peninsular terrane. These rocks include a sequence of marine sediments ranging from Middle Jurassic through Late Cretaceous in age, which has been the target of past exploration ventures. Underlying this sedimentary sequence and exposed in the surrounding mountains is a series of Late Jurassic and older volcanic<sup>3</sup> rocks and metamorphosed<sup>4</sup> volcanic and sedimentary<sup>5</sup>

<sup>3</sup> volcanic rock—a generally finely crystalline or glassy igneous rock resulting from volcanic action at or near the Earth's surface.

<sup>4</sup> metamorphic rock—any rock derived from pre-existing rocks by mineralogical, chemical, and structural changes, essentially in the solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment at depth in the Earth's crust.

<sup>5</sup> sedimentary rock—a rock resulting from the consolidation of loose mechanically formed fragments of older rocks and minerals, or the precipitation of minerals from solution, or the remains of animals and plants.

rocks (Andreasen, et. al., 1964; Jones and Silberling, 1979). Geologic time periods are depicted in Table 2.1.

Gravity and magnetic data suggest that the basin is asymmetrical in cross-section with the major basin axis trending generally eastward across the southern basin area. A smaller depocenter might be present northwest of Gulkana. Structural features are typically east- and northeast-striking faults, fault blocks and folds. Unconformities control the distribution and character of the post-Triassic sediments filling the basin (Andreasen, et. al., 1964).

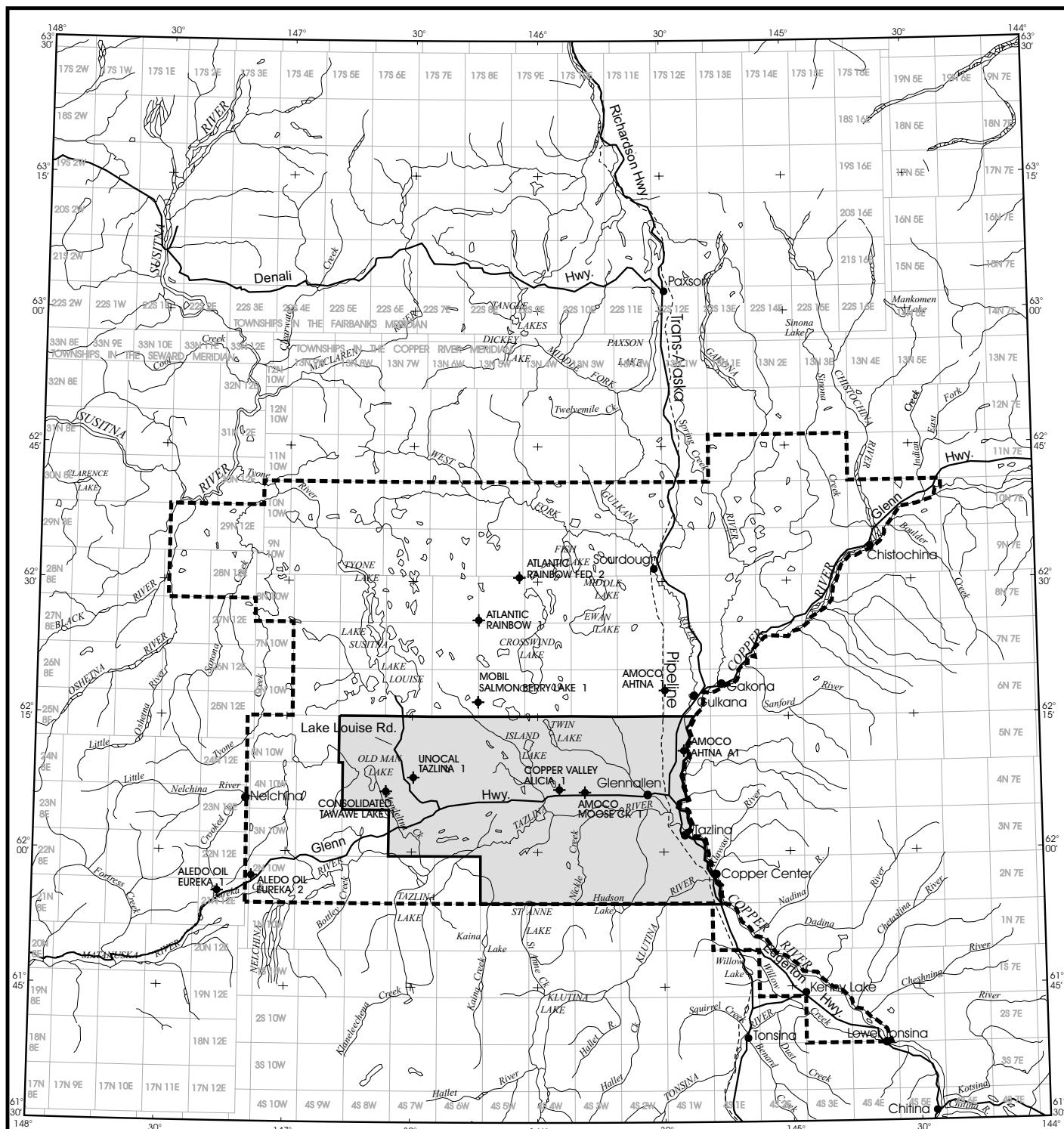
Copper River basin geology is, in part, genetically related to that of Cook Inlet (Jones and Silberling, 1979). Prior to Paleocene and Eocene tectonic activity that created the Talkeetna and Chugach mountains, upper Cook Inlet and Copper River basins were a continuous marine sedimentary basin located along a convergent plate margin. Current geologic and stratigraphic nomenclature reflects this relationship. When appropriate and when clear connections are demonstrated, the same rock formation names are used for rock strata deposited in both the upper Cook Inlet and the Copper River basins at the time this connection existed.

## **D. Exploration History**

Gravity and magnetic geophysical data (Andreasen et. al., 1964; A.D.N.R., 1973; Meyer et. al., 1995, 1996) and geological mapping (Wilson, et. al., 1998) are available for the Copper River basin and the surrounding area although seismic data remain confidential. A total of eleven exploration wells are located in the basin (ADNR, 1999)(See Figure 2.2). Aledo Oil drilled the oldest well, Eureka No. 1 in 1957, in the far southwest corner of the basin. The most recent well, Alicia No. 1, was a shallow well drilled in 1983 by the Copper Valley Machine Works just south of the basin axis, about 12 miles west of Glennallen. The deepest well, Tazlina No. 1, drilled by UNOCAL about 30 miles west of Glennallen, reached a depth of about 8,840 feet. Two wells had small gas shows; Ahtna No. 1 and Ahtna No. A1, both drilled by Amoco in 1980. Two other wells, the Salmonberry Lake Unit No. 1 (Mobil) and the Moose Creek Unit No. 1 (Pan American), required increases in mud weights beyond the weights ordinarily used by the operators to control the flow of water. The water from both of these wells contained small amounts of methane gas. One well, the Tawawe Lake Unit No. 1 (Consolidated Oil) located 33 miles west of Glennallen, had a minor occurrence of residual tar with amber cut, indicating oil had at least migrated through the area. In addition to the occurrence of oil and gas in exploration wells, there are gas seeps characterized by high methane and helium gas content associated with mud volcanoes in the Copper River basin (Wescott and Turner, 1983).

## **E. Petroleum Potential**

In order for an accumulation of hydrocarbons to be recoverable, the underlying geology must be favorable. This may depend on the presence of source and reservoir rock; the depth and time of burial; and the presence of migration routes and geologic traps or reservoirs. Source rocks are organic-rich sediments, generally marine shales, which have been buried for a sufficient time, and with sufficient temperature and pressure to form hydrocarbons. As hydrocarbons are formed, they will naturally progress toward the surface if a migration route exists. An example of a migration route might be a permeable layer of rock in contact with the source layer, or fault fractures that penetrate organic-rich sediments. A hydrocarbon reservoir is permeable rock that



**FIGURE 2.2 Exploratory Wells**

Study Area =

License Area =

Exploratory Well =



SCALE 1:1,000,000 One Inch = 17.5 Miles Approx.

Source: ANDR, DO&G 11/99.

Albers Equal-Area Conic Projection, 1927 North American Datum, Clarke 1866 ellipsoid.

ADNR 5/00



has been geologically sealed at the correct time to form a "trap." The presence of migration routes therefore affects the depth and location where oil or gas may pool and form a reservoir. For a hydrocarbon reservoir to be producible, the reservoir rock must be of sufficient thickness and quality (good permeability and porosity), and must contain a sufficient volume or fill of hydrocarbons to be produced. Another factor used by the division to assess the petroleum potential of the study area is the history of petroleum exploration.

The petroleum potential of the Copper River basin is low to moderate. This represents ADNR's general assessment of the oil and gas potential of the area and is based on a resource evaluation made by the state.<sup>6</sup> This resource evaluation involves several factors including geology, seismic data, exploration history of the area, and proximity to known hydrocarbon accumulations.

Shallow Tertiary sediments in the Salmonberry No. 1 and Rainbow No. 1 wells contain low-rank coal in individual seams up to 30 feet thick, at depths of between 700 and 2,000 feet (Crick and Lian, 1970). Small amounts of biogenic gas may be derived from these shallow coals and thermally immature shales. Few shallow structural features exist, however, to allow entrapment of the gas. Oil and associated gas might be generated by the Middle Jurassic shale in the central basin-deep and trapped by the overlying Late Jurassic and Cretaceous structures and unconformities. Despite the presence of strong petroleum odor on outcrops in the Nelchina area, the volume of the shale source-rock might not be sufficient to generate commercial quantities of hydrocarbons.

Some portions of this area have higher potential because of more favorable geology, while other portions of the area may have lower potential because they are either more distant from the road system, the geology is less favorable, or the exploration history is less encouraging. Areas with lower potential may still contain hydrocarbon accumulations.

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<sup>6</sup> DO&G petroleum geologists map potentially prospective subsurface rock units by using confidential seismic and well data, public well data, production and historical performance information from existing fields, and other published reports.

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